Upper San Joaquin River Basin Storage Investigation

Draft Surface Storage Option Technical Memorandum

Dry Creek Reservoir

Prepared for

U.S. Bureau of Reclamation
Mid Pacific Region

By
MWH
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March 2003

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SURFACE WATER STORAGE OPTION
TECHNICAL MEMORANDUM

DRY CREEK RESERVOIR

UPPER SAN JOAQUIN RIVER BASIN STORAGE INVESTIGATION

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EXECUTIVE SUMMARY

An appraisal-level study of the potential Dry Creek Dam and Reservoir was completed as part of the Upper San Joaquin River Basin Storage Investigation (Investigation). The Investigation is being completed by the U.S. Bureau of Reclamation Mid-Pacific Region, in cooperation with the California Department of Water Resources, consistent with recommendations in the CALFED Bay Delta Program Record of Decision, August 2000.

Dry Creek Dam would be a new structure on Dry Creek, a tributary to the Kaweah River downstream and north of Terminus Dam. As previously proposed by the U.S. Army Corps of Engineers in 1990, the new structure would consist of a 175 foot-high roller compacted concrete dam and spillway across the Dry Creek valley. It would impound a reservoir with a storage capacity of up to 70,000 acre-feet. Excess Kaweah River flows would be conveyed from Lake Kaweah to the new reservoir via a 7,600-foot long, 12-foot diameter tunnel and would be supplemented by local runoff from the Dry Creek watershed.

Water stored in Dry Creek Reservoir would be released to the Kaweah River and diverted to the Friant-Kern Canal or left instream. These flows would be exchanged for water delivered from Millerton Lake via the Friant-Kern Canal or for releases from Millerton Lake to the San Joaquin River. The estimated first cost of constructing Dry Creek Dam and Reservoir is $237 million (2002 dollars).

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CHAPTER 1. INTRODUCTION

The U.S. Bureau of Reclamation (Reclamation), in cooperation with the California Department of Water Resources (DWR), is completing the Upper San Joaquin River Basin Storage Investigation (Investigation) consistent with the CALFED Bay Delta Program Record of Decision (ROD), August 2000. The Investigation will consider opportunities to develop water supplies to contribute to water quality improvements and restoration in San Joaquin River and to enhance conjunctive management and exchanges to provide high quality water to urban areas. The ROD indicated that the Investigation consider enlargement of Friant Dam or development of an equivalent storage program to meet Investigation objectives.

The Investigation identified several potential surface storage sites to be initially considered through appraisal-level studies of engineering and environmental issues. This document presents findings from an appraisal-level review of the potential Dry Creek Dam and Reservoir.

PROJECT DESCRIPTION

The proposed Dry Creek Reservoir would be located in Tulare County, near the community of Lemon Cove, about 25 miles east-northeast of Visalia. The damsite is located on Dry Creek about 1¾ miles north of its confluence with the Kaweah River. The site's general location is shown in Figure 1-1. A map of Dry Creek and vicinity is shown in Figure 1-2.

Dry Creek Reservoir would have the potential to store approximately 70,000 acre-feet of water. Excess Kaweah River flows would be diverted from Lake Kaweah to Dry Creek Reservoir via an interconnecting tunnel and would be supplemented by local drainage from the Dry Creek watershed.

Water stored in Dry Creek Reservoir would be released to the Kaweah River and diverted to the Friant-Kern Canal or left instream. These flows would be exchanged for water delivered from Millerton Lake via the Friant-Kern Canal or for releases from Millerton Lake to the San Joaquin River.

EXISTING FACILITIES

No water storage facility presently exists at the site. Terminus Dam, which impounds Lake Kaweah on the main stem of the Kaweah River, is located approximately 1 mile upstream of the Kaweah's confluence with Dry Creek.

An active sand and gravel quarry (Artesia) is located within and downstream of the proposed Dry Creek Dam site. Sparse rural development occurs within Dry Creek's valley upstream of the site. Paved and unpaved roads provide access to the dam site. Overhead power and telephone lines are present along Dry Creek Drive.

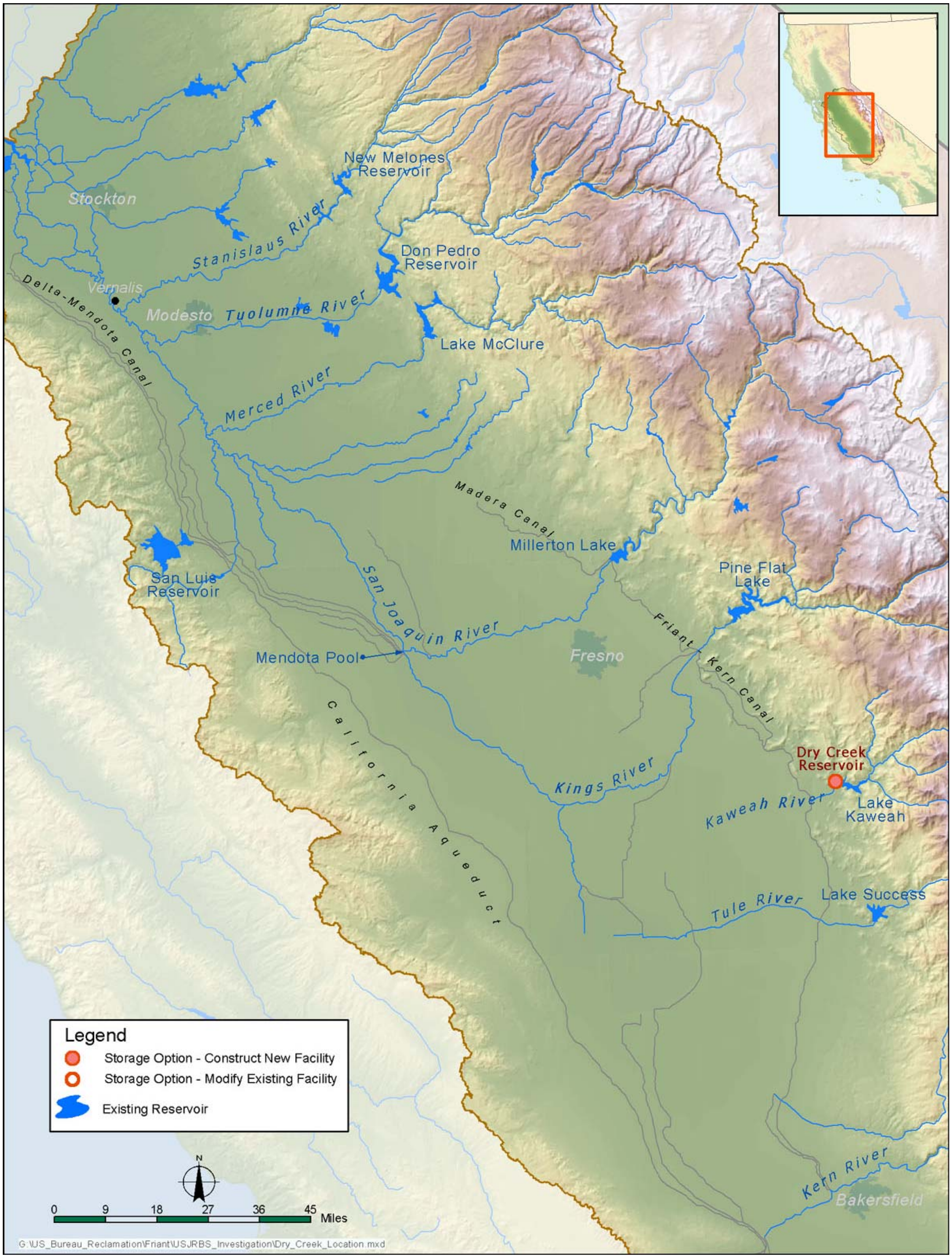

FIGURE 1-1. DRY CREEK RESERVOIR LOCATION MAP

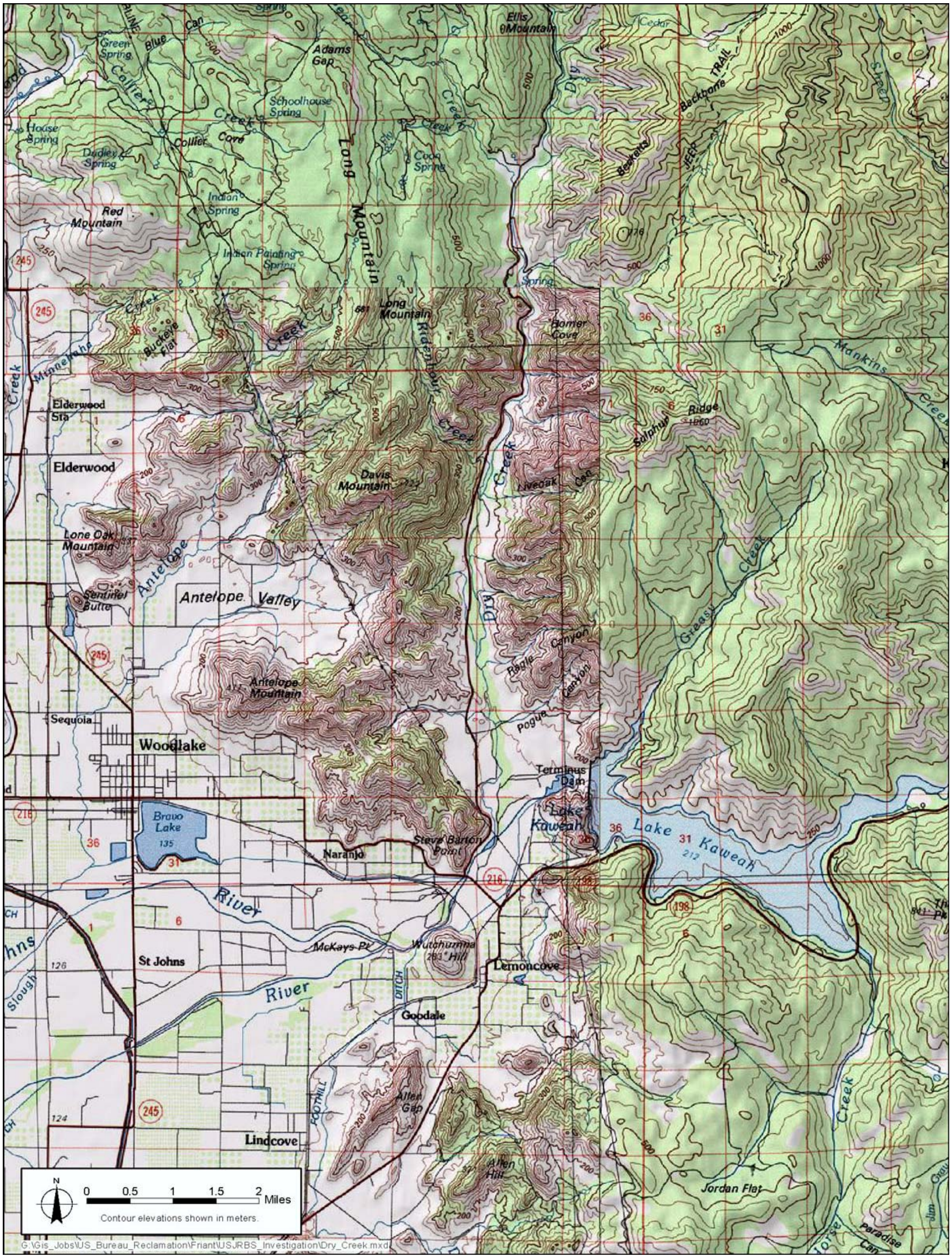

FIGURE 1-2. DRY CREEK AND VICINITY

SUMMARY OF PREVIOUS INVESTIGATIONS

In 1966, the Corps of Engineers produced a planning document summarizing the geology, paleontology, archaeology, flora, fauna, and history of the Terminus Reservoir area. The report was revised two years later.

In 1986, the Corps prepared a Hydrology Reconnaissance Study for the Kaweah and Tule Rivers (COE, 1986). This study was an update of a similar report prepared in 1971.

In 1990, the Corps prepared a feasibility level draft report, Basis of Design and Cost Estimates, for a proposed enlargement of Lake Kaweah (Terminus Dam) and construction of Dry Creek Reservoir (COE, 1990a). For the Dry Creek dam, both rockfill embankment and roller compacted concrete (RCC) types were investigated, and both were found to be feasible. The RCC structure was recommended on the basis of lower first cost.

Also in 1990, in support of the Basis of Design, the Corps prepared a Hydrology Office Report (COE, 1990b). The report summarized the hydrologic information developed for the Kaweah River and its major tributary, Dry Creek. The information was used to provide estimates of the probability of downstream peak flows and flow volumes resulting from various project configurations. Data were also used to design the spillway and other hydraulic features and to determine freeboard and sediment requirements.

In September 1992, the Corps prepared a Draft Integrated Feasibility Report and Environmental Impact Statement describing the results of studies into flooding problems downstream of Terminus Dam. Appendix A of the feasibility report contained the Draft Basis of Design and Cost Estimates. The feasibility report considered 14 structural alternatives for providing increased flood protection and water supply storage for irrigation. These included Lake Kaweah enlargement (raise Terminus Dam spillway); construction of a small (27,000 acre foot) flood control detention basin on Dry Creek in conjunction with enlargement of Lake Kaweah; and construction of a larger (70,000 acre foot) reservoir on Dry Creek connected by tunnel to an enlarged Lake Kaweah. These three structural alternatives were the only ones retained for further study. Although all three were considered economically feasible, it was noted that the two alternatives involving a dam on Dry Creek involved extensive environmental and cultural impacts.

Appendix A of the 1992 feasibility report was essentially an updated version of the 1990 Basis of Design. Slight modifications were made to the Lands Values and the Basis of Cost Estimates (Summary of First Costs) sections. Costs were apparently updated to 1992 criteria from 1990 and a Basis of Annual Costs section was added for the Terminus Dam raise.

In June 1996, the Corps issued a Draft Feasibility Report and a Draft Environmental Impact Statement / Report as a continuation of the Kaweah River Basin Investigation. The Draft EIS evaluated two alternatives involving a 21-foot raise of Terminus Dam's spillway. It reported that other previously considered alternatives had been eliminated. In particular, the two alternatives that involved construction of a dam on Dry Creek in conjunction with Lake Kaweah enlargement were reported as having been eliminated due to high construction costs and extensive environmental and cultural resource effects and mitigation requirements.

PROPOSED IMPROVEMENTS

As proposed in the Corps' 1990 Basis of Design, Dry Creek Dam would be a 175-foot high roller compacted concrete structure with a total crest length of 3,210 feet, including a 102-foot wide, ungated, ogee spillway. From the left abutment (looking downstream), the axis of the dam would extend east-northeast across Dry Creek.

Dry Creek Reservoir would have a storage capacity of approximately 70,000 acre-feet at a gross pool elevation of 684 feet above mean sea level (elevation 684). Flow would be diverted to Dry Creek Reservoir via an interconnecting 7,600-foot long, 12-foot diameter, concrete-lined tunnel (Figure 1-3). Gated or ungated outlets works would be possible. The ungated option would enable the reservoir to be used for flood control storage only. In this case, discharge would be through an ungated steel conduit passing through the dam. The gated option, as previously designed, would allow for 10,000 acre-feet of the total storage capacity to be managed as conservation storage. Discharge in this case would be released through a fixed cone valve.

APPROACH AND METHODOLOGY

This Technical Memorandum was prepared from a brief review of the existing documents identified above, and an engineering field reconnaissance of the dam and reservoir conducted on June 13, 2002 (Appendix A).

The seismotectonic evaluation conducted by Reclamation for this study was based on readily available information and is considered appropriate for appraisal-level designs only. Detailed, site-specific seismotectonic investigations have not been conducted and aerial/remotely-sensed imagery was not evaluated. More detailed, site-specific studies would be required for higher-level designs.

For appraisal level planning studies, designs and analyses are typically quite general. Extensive efforts to optimize the design have not been conducted, and only limited Value Engineering (VE) techniques have been utilized.

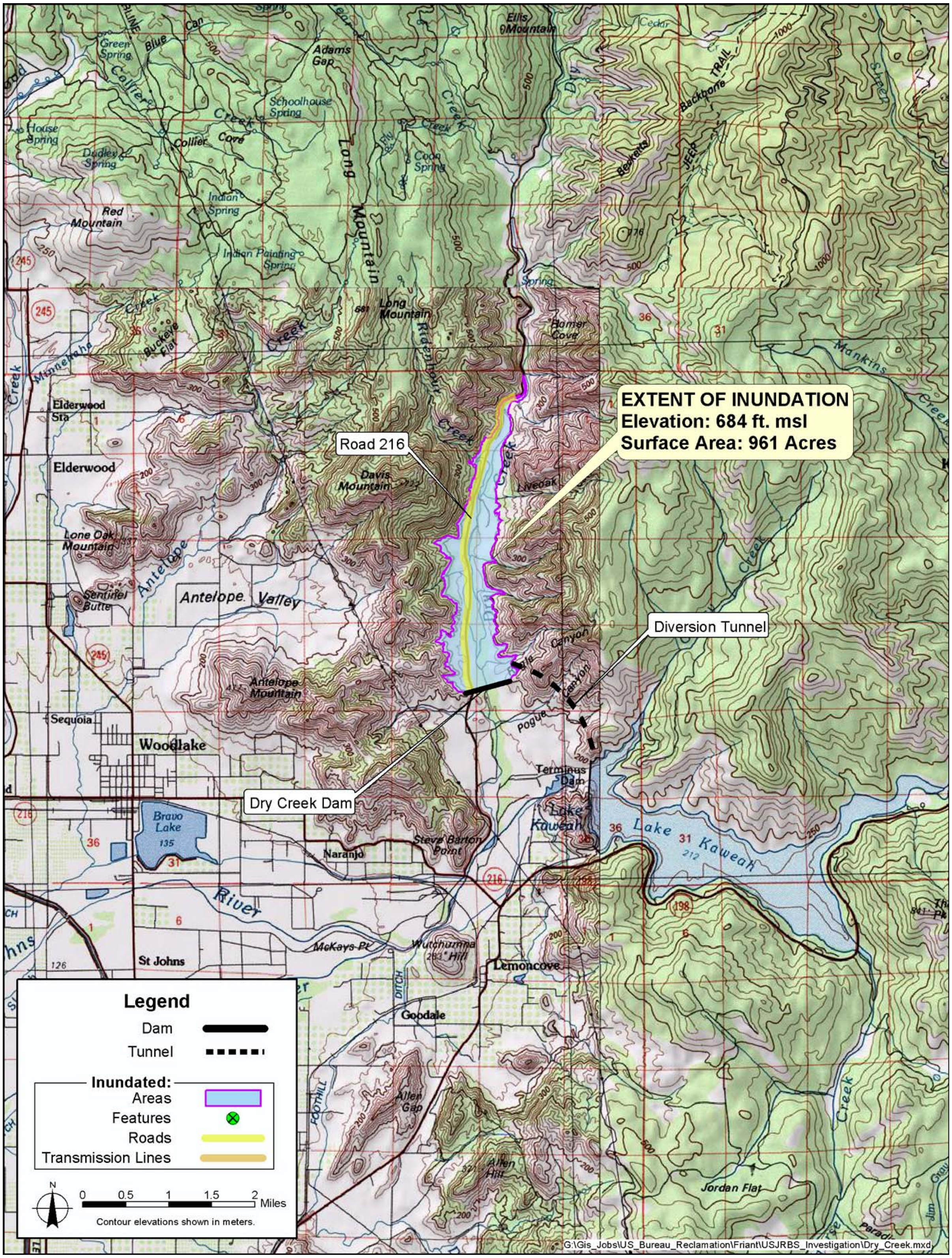

FIGURE 1-3. POTENTIAL PROJECT FEATURES AND INUNDATED FACILITIES

CHAPTER 2. TOPOGRAPHIC SETTING

TOPOGRAPHY

Regional topography consists of the nearly level floor of the San Joaquin Valley rising abruptly to moderately steep, northwest-trending foothills with rounded canyons. Elevations in the immediate area of Dry Creek range from about elevation 530 to over elevation 1,300. Farther east, the terrain steepens and the canyons become more incised. The canyons have been cut by southwest- to west-flowing rivers and associated large tributaries. The Kaweah River is the main river in the area. Dry Creek is a south-flowing tributary to the Kaweah. Its confluence with the Kaweah River is about one mile downstream of Terminus Dam, which creates Lake Kaweah.

The proposed damsite is located at the southern end of the relatively narrow, south-draining, steep-walled Dry Creek valley. The left abutment slope rises at a relatively steep inclination of 2.5:1 (horizontal to vertical), while the right is slightly steeper at about 2:1. The streambed at the axis of proposed dam is at approximately elevation 540. The adjacent abutment ridges rise to nearly elevation 879 (right ridge) and elevation 1,350 (left ridge).

AVAILABLE TOPOGRAPHIC MAPPING

Topographic mapping is publicly available from the U. S. Geological Survey (USGS). No other topographic mapping is known to be available. It appears that base maps used by the Corps in its investigation were from USGS sources.

AVAILABLE AERIAL PHOTOGRAPHY

Aerial photography of various scales and imagery is available from the archive files of the U.S. Geological Survey. Additional aerial imagery may also be available from the U.S. Department of Agriculture, Reclamation, and the Corps. A specific search of the available photography was not performed for this Technical Memorandum nor was any aerial photography reviewed.

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CHAPTER 3. GEOLOGIC AND SEISMIC SETTING

REGIONAL GEOLOGY AND SEISMICITY

The Dry Creek project area is located near the boundary of the Sierra Nevada Geomorphic Province and the San Joaquin Valley portion of the Great Valley Geomorphic Province. The Great Valley basin is filled with thick accumulations of marine (at depth) and non-marine sediments shed largely from the Sierra Nevada mountain range. Recent alluvium of lake and river origin blanket most of the present-day surface, while dissected remnants of Pleistocene alluvial fans rim the valley margin.

The Sierra Nevada range is characterized by batholiths of Mesozoic granitic rock and Paleozoic roof pendants of the Calaveras Complex and related rocks. The Sierra Nevada foothills take the form of outliers of low to irregular hills of Mesozoic granitic and late Paleozoic to Mesozoic basic and ultrabasic rock (ophiolites) of the "serpentine belt" of the Kings-Kaweah suture, as well as other associated Mesozoic metamorphic rocks.

Overall, potential seismic hazard potential at the site is low. Preliminary earthquake loading analysis, for this appraisal-level study, considered two types of potential earthquake sources, fault sources and areal/background sources.

Twenty-two potential fault sources for the project site were identified. This includes those associated with the San Andreas fault, seven western Great Valley faults, seven eastern Sierra Nevada faults, the White Wolf fault of the southern San Joaquin Valley, and six faults of the Sierra Nevada Foothills system. No major through-going or shear zones have been identified in this area of the Sierra Nevada and historic seismicity rates are low.

The areal/background seismic source considered was the South Sierran Source Block (SSSB), the region surrounding the project site. This region possesses relatively uniform seismotectonic characteristics.

Probabilistic seismic hazard analysis shows that the peak horizontal accelerations to be expected at the site are 0.13g with a 2,500-year return period, 0.17g with a 5,000-year return period, and 0.23g with a 10,000-year return period.

SITE GEOLOGY AND FAULTING

The south-trending Dry Creek valley is located in what is probably an erodible zone along a geologic contact between granitic rocks and a Calaveras Complex roof pendant of metamorphic rock and limestone stringers. At the damsite, quartzite and the Lemon Cove Schist, Calaveras Complex rocks, are exposed along both sides of the valley and along much of the perimeter of the proposed reservoir. A small area of Mesozoic granite is exposed along the western margin of the proposed reservoir. Relatively thick Pleistocene and recent river alluvium deposits of sand, gravel, and possible silt are found beneath the floor of Dry Creek.

During the Corps' investigation of the Dry Creek site, metamorphic rock was the most common rock class encountered. In particular, exploratory boreholes advanced by the Corps in 1989 found that mica-quartz (mq) schist with interbedded quartzite was the most common rock type. Other metamorphic rocks included additional schist species (quartz-mica (qm) schist, chlorite (c) schist, biotite chlorite (bc) schist, and a fractional amount of biotite quartz (bq) schist), schistose quartzite, and marble. Biotite quartz diorite (granite) was the only igneous rock encountered, but it was dominant in the particular portion of the site where it was found. Sedimentary rock was limited to a minor amount of sandstone.

No significant faults or fault zones are known to exist within the proposed reservoir basin or dam site.

SITE GEOTECHNICAL CONDITIONS

Metamorphic rocks were found in the proposed locations of the spillway, outlet works, along the dam axis, tunnel, and in a potential quarry area located in the area of the western perimeter of the proposed reservoir. However, in the potential quarry area, metamorphic rocks were not dominant. Schistose quartize composed about 10 percent of the quarry area rock while bq schist made up less than 1 percent. (The balance of the potential quarry area rock was granite.)

In the spillway and outlet works areas, and to a much lesser extent in the quarry area, bc schist and quartzite were encountered. In the spillway and quarry area, the bc schist was primarily medium gray, hard slightly weathered and predominantly aphanitic to fine grained with traces of pyrite, garnet, and chlorite. Foliation in the schist was steep, reported as 15 to 20 degrees from the core axis. Using the assumption that the core holes were vertical, the foliation dipped at 70 to 75 degrees from horizontal. The orientation of the foliation was not reported, but likely parallels the northwest to southeast trend of the Kings – Kaweah suture.

Metamorphic rocks in the outlet works area were interbedded and closely associated, consisting of light olive gray to brownish black and dark gray quartzite and schist that ranged from soft to hard, slightly to moderately weathered, aphanitic, intensely to moderately fractured and abundantly stained with iron-oxide. Foliation in the schist was similar to that in the quarry area, 15 to 20 degrees from the core axis. Numerous ptygmatic folds were observed within the cores.

Along the dam and tunnel axes, qm schist was the most common rock type found. Marble was reported in one dam axis boring and quartzite was found in the other dam locations. Qm schist, quartzite, and marble stringer, were encountered in the tunnel locations. Chlorite schist was noted in one tunnel boring.

The qm schist in the dam locations vary in coloration, dark to medium dark gray to dark greenish gray to grayish olive. It varies from soft to hard, slightly to highly weathered, aphanitic to fine grained, and intensely to highly fractured. Foliations are oriented as in the outlet works area. The qm schist in the tunnel locations is similar to that in the dam area, but hard to very hard, slightly to moderately weathered, and intensely to moderately fractured, and possesses a micaceous sheen and irregular foliation.

The quartzite varied from moderately hard to hard, unweathered to moderately weathered, aphanitic and fine grained, with pyrite. In the tunnel location, the quartzite was also intensely fractured. Quartz stringers were noted in the dam location, while marble stringers were observed in the tunnel location.

Marble, noted in only one dam location, is highly color variable in shades of gray. It is moderately hard to very hard, slightly to highly weathered, aphanitic to fine grained, and highly to moderately fractured.

The c schist, noted in only one tunnel location, is light gray, to dusky yellow green, hard, slightly weathered, and aphanitic to fine grained. Trace levels of calcite crystal-filled vugs were also noted.

A minor amount of sandstone, apparently stream channel-deposited, was noted in one of the spillway borings. The sandstone was light olive brown, soft to moderately soft, coarse to very coarse, slightly to moderately weathered, intensely fractured, and massive. The basal pebble layer consisted of hard, round quartz pebbles.

Granitic rocks were encountered only in a potential quarry site located in the area of the western perimeter of the proposed reservoir. About 90 percent of the rock at the potential quarry area was granite. This rock consisted of light to medium light gray granite that was primarily moderately hard to very hard, slightly weathered, subhedral to euhedral, fine to medium grained, and moderately fractured to unfractured. Iron-oxide stain delineated micro-fractures in the granite surrounding xenoliths found in all locations. Iron oxide staining ranged from non-existent to abundant.

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CHAPTER 4. HYDROLOGIC SETTING

DRAINAGE AREA

Dry Creek is one of three main tributaries to the Kaweah River downstream of Terminus Dam. It enters the Kaweah from the north. Mehrten Creek and Yokohl Creek, the other two principal downstream tributaries are both on the south side of the Kaweah.

Dry Creek extends for about 25 miles and drains approximately 82 square miles. Elevations within the Dry Creek watershed range from about elevation 480 at its confluence with the Kaweah, to about elevation 7,650 in its Sequoia National Forest headwaters.

RAINFALL

Normal annual precipitation over the Dry Creek basin averages 23.4 inches, ranging from about 14 inches at its confluence with the Kaweah River to a little over 40 inches in its headwaters.

EROSION, RUNOFF, AND RECHARGE

Along Dry Creek, the soil series consists mainly of well drained and gently sloping sandy loam. The surface layer is dark gray and gray sandy loam with moderately rapid permeability and a low erosion hazard. Soils on the bottom of Dry Creek consist of the Tujunga series. This sandy soil is a very deep soil layer of high permeability and low available water capacity. The slope is smooth with a mild erosion hazard (COE, 1996).

Sedimentation rates for the proposed Dry Creek Reservoir were not evaluated by the Corps. The Corps' analysis of sedimentation conditions downstream of the proposed dam indicated that approximately 1.7 feet of streambed degradation could be expected in the process of developing a heavier armor. Streambed degradation could be precluded through use of an existing, low-flow concrete water crossing, located about a mile downstream, that would act as a grade control structure. Near its confluence with the Kaweah River, the Dry Creek channel widens, passing through a broad sluggish reach that will preclude degradation. Finally, a low level dam on the Kaweah, just downstream of the Dry Creek confluence, and Kaweah bed armoring will also provide grade control.

Flows in Dry Creek are the result of rainfall only, since the watershed is below elevations where significant snow accumulates. Winter rain floods generally occur from November through April, are characterized by sharp peaks with most of the volume occurring within a few days.

The average annual runoff from Dry Creek is 19,059 acre-feet (COE, 1996). Historical peak flow at Dry Creek was recorded 6 Dec 1966 at 14,500 cubic feet per second (cfs), with maximum 1-day flow of 6,300 cfs. This is based upon a record from 1960 through 1986.

AVAILABLE FLOOD DATA

Flow frequency data reported by the Corps dates back to 1960. The largest rain flow of record for Dry Creek was in December 1966 (14,500 cfs); the second largest flow of record was January 1969 (6,020 cfs), followed by April 1982 (3,895 cfs).

A Standard Project Flood (SPF) volume of 33,000 acre-feet, and a peak of about 23,000 cfs, was calculated for a specific event over the Dry Creek drainage (COE, 1996).

The Probable Maximum Flood (PMF) from a 1971 study was recomputed in 1988 and used as the design flood for Dry Creek. HEC-1 was used to calculate the 1988 PMF Hydrograph. In the model, a total of 29.35 inches of precipitation occur over the Dry Creek Basin over 3.5 days. The peak inflow was determined to be 45,000 cfs and the PMF volume was 64,600 acre-feet (COE, 1990b).

Spillway size was selected through routing of the PMF through the spillway. Spillway maximum outflow was set at 36,000 cfs.

CHAPTER 5. ENVIRONMENTAL SETTING

INTRODUCTION

This chapter describes existing environmental resources at the site and qualitatively describes potential effects of reservoir development. The discussion in this chapter is intended to indicate the extent to which expected or potential environmental effects might pose a constraint to reservoir development. Where evident, opportunities for improving environmental resources or mitigating adverse effects have been noted. The analysis concentrated on botany, terrestrial wildlife, aquatic biology, recreational resources, cultural resources, and existing land uses. Mining and other known past activities that might affect site conditions are also briefly discussed, along with the potential presence of hazardous or toxic materials. Temporary construction related disruptions and impacts are discussed in Chapter 6.

The identification of constraints was conducted at a preliminary, appraisal level of planning, consistent with the current phase of the Investigation. Criteria considered were based, in part, upon criteria commonly used to evaluate environmental impacts of projects under the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). The application of criteria that may be used for NEPA or CEQA evaluation does not imply that the analysis is at a level that would be needed for an Environmental Impact Statement or Environmental Impact Report. Considerations included: presence of special status species (e.g. species listed as endangered or threatened), species of concern, or sensitive habitats; relative amounts of affected riparian or wetland habitat; effects on native or game fish; conflict with established recreational uses or land uses; presence of nationally registered historic places, sacred Native American sites, or traditional cultural properties; permanent disruption or division of established communities; and loss of energy production facilities.

BOTANY

Overview of Existing Conditions

The site has grassland and a small amount of foothill pine and oak woodland habitats. Vernal pools and other wetlands could also be present in the flatter valley bottom.

A substantial strip of riparian vegetation occurs along Dry Creek. The California Natural Diversity Data Base (CNDDB) reports sycamore alluvial woodland near the confluence of Dry Creek and the Kaweah River. Although sycamore trees may be common, sycamore alluvial woodland has been described as a “very rare and essentially irreplaceable habitat” and the Dry Creek stand in particular as one of the largest in the Central Valley (Carson, 1989). There are fewer than six viable occurrences and/or less than 2,000 acres in California and worldwide (Prose, 2002).

Thirteen special-status species are recorded around the Dry Creek area. Of these, five have threatened or endangered status. A population of Kaweah brodiaea (state-listed as endangered) occurs along Dry Creek between Kaweah River and Pogue Canyon, slightly downstream of the proposed damsite. In addition, a very large population (over 100,000 plants) of spiny-sepaled button-celery, a California Native Plant Society (CNPS) List 1B species, occurs along Dry Creek between Kaweah River and Ragle Canyon, slightly north of the proposed damsite.

Constraints

The greatest constraint to creation of Dry Creek Reservoir would be the substantial loss of riparian habitat and sycamore alluvial woodland. Reservoir construction and water diversion are considered threats to sycamore alluvial woodland, as sycamores have little tolerance to artificially manipulated water levels (Prose, 2002). In addition, sexual regeneration of sycamore alluvial woodland depends upon substantial scour caused by flood events (Enstrom, 2002). Consequently, construction of the Dry Creek Dam and Reservoir would be likely to negatively affect this resource. Replacement of sycamore alluvial woodland is considered unlikely to be successful and its destruction unmitigable (Enstrom, 2002).

Loss of a state-listed endangered species (Kaweah brodiaea) also poses a constraint to development of this storage option. Reservoir creation would also result in loss of a very large population of a CNPS List 1B species (spiny-sepaled button-celery).

Opportunities

The loss of riparian habitat would likely be much too large to mitigate on-site, so an off-site location would be needed. It is not clear how to offset loss of special status plants with particular environmental requirements. Resource agencies consider adverse impacts to sycamore alluvial woodland to be unmitigable.

WILDLIFE

Overview of Existing Conditions

The wide streambed hosts relatively well-developed riparian woodland. As mentioned above, a large stand of sycamore alluvial woodland is found near Dry Creek's confluence with the Kaweah River. This type of woodland provides important habitat for wildlife (Prose, 2002).

Adjacent foothills are vegetated with grasslands and foothill pine and oak woodland habitats. Known wildlife sensitivities for the area include western pond turtle, a California Species of Special Concern. It is present in Lake Kaweah and Yokohl Valley, so the turtle may also occur in Dry Creek. The San Joaquin kit fox is also known to inhabit the area. Vernal pools occur in adjacent areas and they may occur near Dry Creek, but are not expected within the potential inundation zone. The California condor nests in the Blue Ridge Reserve, but the reserve is several miles from the dam site and should not be affected by construction.

Constraints

Loss of sycamore alluvial woodland, discussed under botany, and loss of riparian habitat in Dry Creek may be the most critical issues from a wildlife perspective. Riparian habitat may host sensitive species such as willow flycatcher, foothill yellow-legged frog, and western pond turtle. However, the only special status species potentially affected is the San Joaquin kit fox. Although the kit fox is on the federal endangered list, impacts to it can be mitigated.

AQUATIC BIOLOGY/WATER QUALITY

Overview of Existing Conditions

Information on flow conditions of Dry Creek was not readily available at the time of this environmental review. However, water flow in Dry Creek is expected to be intermittent. Good water quality would be expected during and shortly after significant rainfall events, but declining as flow recedes.

If the creek is not dewatered during the dry season, it may contain bullfrogs and fish, including California roach and mosquito fish. The San Joaquin form of the California roach has been designated a State Species of Special Concern. Its presence in Dry Creek would require investigation.

Constraints

The principal effects of this option on aquatic biological resources result from replacement of stream habitat with lacustrine habitat. Populations of fish and other organisms adapted to stream environments would be reduced or eliminated from inundated areas, while those of species adapted to lacustrine conditions would be enhanced. The most likely native fish species to be affected by the measure would be California roach, generally not found in lakes.

Releases from Dry Creek Reservoir would potentially affect habitat and water quality in the lower Kaweah River. However, more information about existing water quality in the lower Kaweah River and about likely water quality of releases from the new Dry Creek Reservoir are needed to evaluate this option.

Opportunities

The principal opportunity afforded by this measure is substantial new fish habitat created by the reservoir. The new habitat would probably support a warm-water species only, as the proposed Dry Creek Reservoir would be relatively shallow. By way of comparison, Lake Success, an existing shallow reservoir in the region, is weakly stratified with respect to temperature during summer and strongly stratified with respect to dissolved oxygen concentration and therefore does not support a cold-water fishery. If the proposed Dry Creek Reservoir had similar water temperature and dissolved oxygen conditions, it would support a warm-water fishery only.

Most fish populations originally stocked in Dry Creek Reservoir would probably be self-sustaining, assuming sufficient carryover storage. Fish habitat in the proposed reservoir could be greatly improved if the dam were operated to minimize water level fluctuations, at least during times of year important for fish spawning and rearing.

RECREATION

Overview of Existing Conditions

The proposed dam and reservoir would be situated on private property. No developed recreation facilities occur along Dry Creek and heavy dispersed use along Dry Creek is unlikely owing to private property.

Constraints

Constructing Dry Creek Dam and Reservoir is not expected to result in adverse impacts to recreation resources in the vicinity of Dry Creek.

Dry Creek Reservoir would be filled by diverting water from Kaweah Reservoir and by natural flows from Dry Creek. Assuming only excess flood flows were diverted from Lake Kaweah that would otherwise have been released, creation of Dry Creek Reservoir would not affect water levels at Kaweah Reservoir. Consequently, recreation activities and opportunities at Kaweah Reservoir would be unaffected.

Opportunities

Creation of Dry Creek Reservoir would not be expected to result in adverse impacts to recreation, so no mitigation would be required. Given the relatively small reservoir being considered, no new recreation opportunities would be created in the area.

CULTURAL RESOURCES

Overview of Existing Conditions

The Dry Creek drainage north of Liveoak Canyon, about 2-miles north of the proposed damsite, was traditional territory of the Waksachi people, a transitional Yokuts-Western Mono group (Spier 1978a: 426-427). Spier suggests that from Liveoak Canyon south to the Kaweah River confluence, the Dry Creek drainage was traditional territory of the Gawia Foothill Yokuts people (1978b:471). However, Jackson (et al. 1990) and Roper (1997) document specific sites in the lower reaches of Dry Creek that are affiliated with Wukchumni Yokuts people. Thus, the upper reaches of the potential Dry Creek Reservoir are within Waksachi territory, while the major portion of the reservoir is in an area that may be either Gawia or Wukchumni.

However, it is important to keep in mind that territorial boundaries were but loosely maintained, and people frequently traveled into adjacent territories to trade and to exploit certain sorts of resources thought of as common property for all residents of a region (see Gayton 1948:55). Wukchumni people have shown considerable interest in the area immediately south of the potential dam (Roper 1997).

Gawia descendants live primarily at the Tule River Indian Reservation. Wukchumni people live in Visalia, Fresno, Farmerville, Selma and other settlements. Waksachi descendants live scattered around a number of small settlements in the area, including Selma (southeast of Fresno) and Squaw Valley, Dunlap, and Auckland, all north of Lake Kaweah (White 1996).

The Dry Creek vicinity first came to archaeological attention in the 1920s (Steward 1929). In the 1980s, R. J. Cantwell surveyed the Artesia Ready Mix sand and gravel site located approximately where the proposed Dry Creek Reservoir would be built; no sites were recorded at that time (Cantwell 1984). A later survey (Jackson et al. 1990) identified 29 archaeological sites in the Dry Creek Valley. Several are within the proposed reservoir area, but details are not presently available.

The Dry Creek area history is summarized in an overview document by Meighan (et al. 1988). The earliest documented production activity near Dry Creek was limestone mining at Limekiln Hill, south of the project site near Terminus Dam, beginning around 1859. The Homestead Act of 1862 facilitated settlement in the area, and many settlers were involved in raising cattle, sheep, or horses. Citrus groves were planted as early as 1877.

Constraints

Some cultural resources are known to be present, and there may be additional sites not yet recorded. Inundation of archaeological sites (prehistoric or historic) can result in loss of important scientific data. As many as 29 archaeological sites (possibly more), could be adversely affected by construction of Dry Creek Reservoir. No properties eligible for the National Register of Historical Places are known in the area that would be affected, but future study is likely to identify such properties. No Native American sacred sites or Traditional Cultural Places are known to occur, but Waksachi, Wukchumni, and Gawia Yokuts concerns would be expected.

Opportunities

Inundation damage to archaeological sites can be mitigated with scientific data recovery programs. Reservoir projects also provide an opportunity for public interpretation of the past. Ancillary project facilities, such as roads, power lines, or other structures, might avoid impact to archaeological sites through design or facility placement.

LAND USE

Overview of Existing Conditions

The site is generally undeveloped with the exception of a large, active sand and gravel quarry, and a few rural properties (two dwellings and miscellaneous farm buildings and corrals), including what is identified on USGS topographic maps as the Horner Ranch.

Constraints

Although it would be undesirable to remove and relocate an active commercial operation, the presence of the quarry is not considered a serious constraint for this project. Further investigation of the county General Plan and Zoning Ordinance would contribute additional information needed to determine the degree to which this measure would be constrained from a land use point of view.

MINING AND OTHER PAST ACTIVITIES

Overview of Existing Conditions

A sand and gravel quarry is in operation within the Dry Creek project site. Prior mining within the watershed consisted of tungsten, gem, minerals, and limestone (COE, 1992).

Constraints

Beyond cultural resource concerns discussed above, no constraints related to past activities have been identified.

HAZARDOUS AND TOXIC MATERIALS

Overview of Existing Conditions

The rural and ranch properties may possess, or might once have possessed underground or above ground petroleum hydrocarbon storage tanks and/or electrical transformers containing polychlorinated biphenyls (PCBs) . Rural residences usually have septic systems. Pesticide data collected along Dry Creek in 1988 did not indicate impacts (COE, 1992).

Constraints

Potential impacts to the site from septic systems, fuel and lubricant hydrocarbons, and/or from electrical transformers may exist on the site and could require remediation.

CHAPTER 6. STORAGE STRUCTURES AND APPURTENANT FEATURES

ROLLER COMPACTED CONCRETE DAM

The proposed Dry Creek Dam would consist of a 200-foot high roller compacted concrete (RCC) dam, relative to the excavated stream bed. Relative to the existing stream bed invert, the structure would be 175 ft high. The dam would be founded on firm rock materials. The total crest length would be 3,210 feet. The non-flow portion of the dam crest would be about 3,110 feet long and 25 feet wide. A 102-foot wide, ungated, ogee spillway would crest at elevation 684.

The upstream dam face would be vertical, while the downstream dam face would have a slope of 0.65:1 (horizontal to vertical). The roadway on the dam crest would be at elevation 705 and the top of parapet wall at elevation 708. The total freeboard (3 ft) is based on total wave runup and wind setup of 2.5 feet.

Figure 6-1 is a dam cross section from the 1990 Corps study.

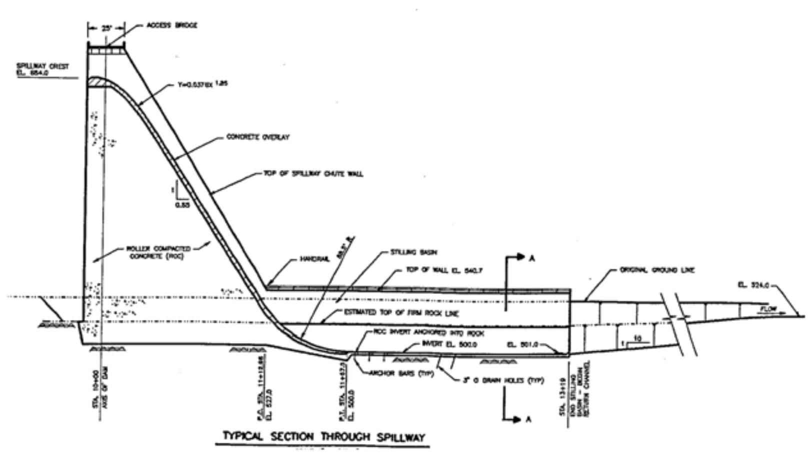

FIGURE 6-1. DAM CROSS-SECTION

It is estimated that approximately 1.4 million tons of aggregate and 720,000 tons of sand would be required to construct the RCC dam. An estimated 67,000 tons of Portland cement and 32,000 tons of pozzolan would also be required.

RESERVOIR AREA/ELEVATION/CAPACITY CURVES

Reservoir areas versus storage data were not contained in the documents reviewed.

CONSTRUCTABILITY

Land, Right-of Way, Access, and Easements

Construction of Dry Creek Dam and Reservoir would require real estate acquisition and relocation of 3 dwellings (one new) and 2 corrals, and the acquisition of 9 ownerships in fee. Am easement similar to a pipeline easement would be required for the tunnel alignment. The Corps (1992) estimated the real estate costs at $1,151,500.

The existing road into and through the valley, Dry Creek Drive, provides access to the sparsely settled property within the valley. The cost to relocate the access road was previously estimated as $5.2 million (COE, 1992)

Property within the limits of the gross pool level would require 1,540 acres of light clearing.

Borrow Sources/Materials

There appear to be sufficient materials within the Dry Creek channel alluvium to meet project requirements. The Dry Creek alluvium was investigated through excavation and analysis of samples from twelve backhoe pits as to its capability in providing the needed borrow materials for construction. An estimated 4.1 million cubic yards of material suitable for the project were identified within the upper 15 to 24 feet of the existing ground surface. The sand to coarse aggregate ratio ranged from 56 to 44 percent.

Portland cement is available from nearby commercial sources, including six producers within a few hundred miles of the project site. Bulk transport to the site could be provided by truck or railcar. Pozzolan is available locally from producers in Stockton or Sacramento.

Foundations

It is anticipated that the dam foundation would be in relatively hard rock with relatively tight, medium to closely spaced fractures and joints. Pre-split drilling and light blasting might be required for excavation. Some soft, sheared zones could be encountered, but they could be backfilled with lean concrete for minor dental preparation of the foundations.

Power Sources

Electrical power is available from the powerhouse at Terminus Dam or other nearby commercial sources.

Staging and Lay Down Area

Potential staging and lay down areas are located immediately upstream and downstream of the project site.

Contractor Availability and Resources

The are several local general engineering contractors or regionally based general engineering contractors capable of performing the rock excavation, concrete forming and placement, RCC dam construction, and general grading and excavation.

Construction Schedule and Seasonal Constraints

Because of the relatively low elevation and low rainfall, there would be minimal seasonal constraints. Construction would be expected to be carried out year round.

Flood Routing During Construction

A diversion structure or pipe would be required to pass potential rain flows during construction. This diversion structure would be plugged once the RCC nears the design height.

Environmental Impacts During Construction

Environmental impacts during construction could be mitigated with proper planning and implementation of best management practices. The work site is not near urbanized areas; therefore, visual impacts would be minimal and few humans would be affected by noise.

The access road would require re-routing. Access by the general public could be restricted during construction, except for those property owners with lands upstream and American Indians requiring access to their tribal lands. Importing construction materials from distant sources would cause traffic impacts, but with proper planning and coordination with Caltrans, the major impacts could be mitigated. Truck traffic for importing materials would discharge exhaust to the local air basin, as would excavation equipment. Other air quality issues related to dust from spillway excavation and berm construction could be mitigated by dust control measures.

A cultural survey would be conducted to identify any ancestral American Indian or historic artifacts and construction activities could be restricted as necessary. Bald eagle sightings have been made within the region.

All construction equipment should have spark arresters and fire control equipment should be kept readily accessible during construction. Construction water would have to be controlled and provisions for runoff and erosion control would need to be developed and implemented. A spill control plan would be needed to control any construction related fuels, lubricants, and other materials.

Permits

It is probable that both federal and non-federal sponsors would be involved in the project. Joint sponsorship complicates the permitting process somewhat as federal projects are not subjected to the same level of permitting that are required for non-federal projects.

Given the probable duality of sponsorship, and potential environmental and cultural impacts identified, at a minimum, the following permits and permitting agencies may become involved:

Permit	**Permitting Agency**
Permit to Construct	DSOD, Tulare County
Encroachment	Caltrans, Tulare County
Air Quality	CARB, Tulare County
Low/No Threat NPDES	RWQCB
Waste Discharge	RWQCB
401 Certification	SWRCB
Blasting	Tulare County
Stream Bed Alteration	CDFG
Fire/Burn	CDF, Tulare County

In addition, the following agencies could be involved in the review of permit conditions:

- Bureau of Indian Affairs
- Bureau of Land Management
- State Historic Preservation Office
- Advisory Council on Historic Preservation
- U.S. Fish and Wildlife Service

In obtaining these various permits, several plans would have to be prepared, submitted to the responsible agencies for review and approval. Some of these include:

- Construction Plan and Summary Documents
- Quality Control Inspection Plan
- Highway Notification Plan
- Blasting Plan
- Noise Monitoring Plan
- Water Quality Monitoring Plan
- Noxious Weed Control Plan
- Bat Protection Plan
- Management Plan for Avoidance and Protection of Historic and Cultural Properties
- Storm Water Pollution Prevention Plan
- Spill Prevention/Containment Plan
- Visual Quality Control Plan
- Dust Control and Air Quality Plan

Another important regulatory requirement involves compensation /mitigation for habitat loss. In October 1998, the U.S. Fish and Wildlife Service (FWS) issued their draft Coordination Act Report and Habitat Evaluation Procedure (HEP Analysis). The HEP Analysis delineates how compensation for adversely affected baseline habitat and wildlife conditions is to be determined.

APPURTENANT FEATURES

Conveyance

A 7,600-foot long, 10-foot diameter diversion tunnel would be required to divert excess water from Kaweah Lake. It is expected that most of the tunnel would pass through pre-Cretaceous metamorphic rock. Tunnel flow would be regulated by slide gates at the upstream end. A vertical access shaft would be cut from the ground surface to the gate location. The invert elevation at Lake Kaweah would be at elevation 600 and the tunnel would have a minimum slope of 0.001 ft/ft.

Pumping Plants

Water would be diverted from Lake Kaweah by gravity. No pumping plants are therefore planned.

COSTS

Initial Construction Costs

Based on both the 1990 and 1992 Corps studies, the cost estimate for the proposed Dry Creek Dam and Reservoir was updated to April 2002 unit costs using Reclamation Construction Cost Trends. Costs were modified as warranted to reflect current material costs and standards of practice especially with respect to seismic requirements. Summaries of the estimated costs are presented in Table 6-1 and Appendix B.

The estimated total first cost for the proposed Dry Creek Dam and Reservoir project is $237 million. Field costs represent the estimated cost to construct identified features, plus provisions for unlisted items (15 percent), contingencies (25 percent), and mitigation (5 percent). Total project costs include field costs plus estimated costs for future analyses and planning documentation, development of designs, and construction management (15 percent).

TABLE 6-1
ESTIMATED PROJECT FIRST COST

Component	2002 Cost (Millions)
Main Dam, Spillway, Outlet Works	$110.0
Diversion and Care of River	$1.5
Diversion Tunnel	$22.8
Unlisted Items	$20.2
Contingency	$39
Mitigation	$10
Total Field Cost	$204
Invest/Design/CM	$31
Land	$2
Total Project First Cost	**$237**

Operations and Maintenance Costs

Operations and maintenance (O&M) costs were not evaluated in any of the previous studies of the proposed Mill Creek project and have not been estimated for this appraisal level report.

SYSTEMS OPERATIONS

Water stored in Dry Creek Reservoir would be released to the Kaweah River and diverted to the Friant-Kern Canal or left instream. These flows would be exchanged for water delivered from Millerton Lake via the Friant-Kern Canal or released from Millerton Lake to the San Joaquin River.

CHAPTER 7. HYDROELECTRIC POWER OPTIONS

PUMPED STORAGE CONSIDERATIONS

Pumped storage is not a viable option for this project

ADDED HYDROELECTRIC POWER TO EXISTING STRUCTURES

There are no existing water storage or hydroelectric structures on Dry Creek.

NEW HYDROELECTRIC POWER

Hydroelectric power generation could be considered for a new dam on Dry Creek. Past investigations for this site focused on flood control and irrigation water supply purposes.

TRANSMISSION AND DISTRIBUTION

Existing transmission and distribution facilities are located nearby.

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